A Work Project, presented as part of the requirements for the Award of a Master Degree in Finance from the NOVA – School of Business and Economics.

"International diversification in a correlated world"

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1.0 Abstract

In this paper I look at the correlation between developed and emerging markets, arguing that the increased correlation has reduced the potential benefits of international diversification. Furthermore, I look at markets that still seem to be highly uncorrelated to developed markets, and how to more efficiently include these in a global portfolio. By ranking emerging markets based on their 12 month rolling correlation coefficient to the MSCI World Index, the country weightings are determined. A global portfolio with different constraints is then created to demonstrate that investors can boost risk adjusted performance by using a more selective correlation based investment approach.

Keywords

1) Emerging markets
2) International Diversification
3) Market correlation

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2.0 Introduction

Investing in foreign markets and in particular emerging markets is often suggested as a way to construct a more diversified portfolio. For investors, Emerging markets are underlined as markets with the prospects of potentially higher returns as they often experience greater economic growth. However, the real benefit lays in the significant lower correlation of emerging markets compared to developed markets. The possible lack of correlation between emerging markets and the developed markets implies that a portfolio combining securities from these two markets should reduce the portfolio's risk without necessarily reducing its return. (Balarezo, 2010)

Correlation is a critical characteristic when considering international diversification as it measures the movement of an asset relative to another asset. Correlation coefficients range from being perfectly negatively correlated -1 where assets move in the opposite direction of each other, and on the other side perfectly positively correlated +1 where assets are moving together. A coefficient of zero would therefore imply that the assets move completely independently of each other. Correlation plays a central role in portfolio theory because it means that combining imperfectly correlated assets (anything with a coefficient between -1 and +1) will reduce portfolio volatility and increase the expected return at any level of risk.

However, the formidable growth of emerging economies in recent years has changed the investment universe for investors. Emerging markets now represents over 10% of the world market cap, and are in many ways behaving more like the developed markets. From an investors perspectives this implies that the possible diversification benefits has been reduced due to the co movements of markets.

3.0 Literature review

3.1 International diversification

The concept of International diversification popular among many investors, and a number of papers and studies can be found on the topic. One of the most famous theories of asset management can also be linked to the topic. Henry Markowitz (1952) was the first to develop a framework for the diversification of financial assets and his findings are still central in modern portfolio construction. To diversify, Modern Portfolio Theory suggests combining stocks that do not perfectly correlate with one another. The main objective of the theory is to minimize risk for a given return. The way to achieve this is to put together a well-diversified portfolio. This is done by finding the portfolio that yields the highest return given a desired risk, or find the portfolio that gives the least risk of the desired return. According to Markowitz, a portfolio manager is risk averse and will base his portfolio choice on expected returns and standard deviation. The expected return is seen as the potential benefit of the portfolio, while the standard deviation or volatility is the measure of risk. (Markowitz, 1952)

Based on the modern portfolio theory it is easy to understand the benefits of international diversification. Local securities are more likely to be influenced by the same domestic conditions like interest rates, inflation and other macroeconomic events. Consequently, assets tend to be more correlated in the national stock markets which will in turn limit the diversification benefits. (Balarezo, 2010)

This has been the very basis for a number of studies. Levy and Sarnat (1970) argues that the low correlation between the US market and other developed countries offers the possibility of a significant risk reduction and that a higher risk adjusted performance can be achieved. Solnik (1974) supported this view and illustrated that

combining stocks from the US and European countries generated portfolios that were half as risky as well-diversified portfolios from the US market alone.

Other research looks at the specifically at emerging markets. DeFusco, Geppert and Tsetsekos (1996) used a co-integration tests to examine the long-run diversification benefits of 13 emerging markets in Asia, Europe and Latin America. Their research showed no co-integration between the emerging markets studied and that the correlations among the returns from these countries were low on average and occasionally negative which implies that diversification across these countries is effective. This view is also supported by Gilmore and McManus (2002) who suggest that US investors can obtain benefits of diversifying using the emerging markets in Europe. Most literature on the topic is from the perspective of the US investor arguing that there are substantial gains by investing internationally. Eun and Resnick (1994) however, also looks at the perspective for Japanese investors presenting that the diversification benefits for Japanese investors are much more limited compared to the US investors. This is interesting because it highlights the fact that the international diversification potential will vary between markets.

French and Poterba (1991) also highlights the great benefits of diversifying internationally, but argue that investors are not taking advantage of this as there seems to be a huge home bias among investors. According to the study, over 80% of British and US portfolios are held domestically.

3.2 Increasing market correlation

As previously discussed the benefits of international diversification is based on the concept that returns in various stock markets around the world is not perfectly positively correlated. Thus one can expect lower correlation between returns on investment in different countries than between investments within a given country.

However, many empirical studies have shown increasing correlation in world markets. Kelly, Eiteman and Stonehill (2012) conducted a correlation analysis to investigate whether the stock market in the US and selected countries became more correlated over spesific time periods of 10 years. The study investigated the correlation between 1977-1986 and 1987-1996 and concluded that there was a clear trend of increasing correlation. All the countries in the study except Denmark, showed a significantly increasing correlation over the period. Furthermore, they argued that correlations have increased over time and that this trend seems to continue, yet there are still diversification opportunities as countries are far from perfectly correlated. (Kelly, Eiteman and Stonehill , 2012)

A number of recent studies in the field support the view of a reduction in the benefits of diversifying internationally due to increasing correlation between international securities markets. A study by You and Daigler (2009) shows that the improvement of international investment depends on which stock indices are being compared to and the factors that are being considered. Benefits of international investment will also vary over time due to changes in conditional correlation. The conditional correlation results from the study, implied that the benefit of international diversification measured by correlation varies over time. The time-varying correlation between the US and European markets shows a positive trend over time, indicating a reduction in the benefit of diversification between the US and European markets. According to Bodie et al. (2008), the correlation between US and European has escalated significantly over the last two decades. Illustrated by the average correlation coefficient of 0.4 in mid 1990 to 0.8 in 2000. This can partially be explained by a reduction in restrictions and regulations for trading abroad. Another possible explanation is the fact that many larger companies are now listed in more than one

country. Longon and Solnik (1995) studied correlation of the big countries arguing that correlation is not constant, and that correlation between developed markets increased significantly over the period 1960-90.

Leading investment banks such as Blackrock (2011) has also highlighted the increasing correlation. Blackrock also argues that correlation differs greatly between countries and it is not stable throughout time. Yet, Blackrock also highlights that correlation seems to be increasing and that developed and emerging markets are currently highly correlated, suggesting that investors should start looking into frontier markets.

Goetzmann and Rouwenhorst (2005) looks at emerging market correlation over a longer time horizon and discusses that globalization has increased the investment opportunities available to international investors. However this advantage has been offset by the increasing correlation. Moreover Goetzmann and Rouwenhorst looks at the important role of emerging markets and that emerging markets diversification benefits is smaller in a capitalization weighted international portfolio such as the MSCI index compared to an equally weighted international portfolio.

3.3 Correlation in bear markets

There are also studies suggesting that the benefits of international diversification seems to be significantly lower in bear markets (Campbell, Koedijk and Kofman, 2002). Butler and Joaquin (2002) highlights that stock market correlations are significantly higher than normal in bear markets, and that international diversification will fail to serve as a protection mechanism and yield the promised returns when it is needed the most.

According to Kindleberger and Aliber (2005), small changes in stock prices will cause a low correlation between stock price movements in different national markets.

An increase in share price movements will lead to a higher correlation, and as a result there will be higher correlation in crisis and periods of downturns when volatility is high. Furthermore, the paper argues that the pattern of correlation between changes in stock prices in different markets is asymmetric, for example, US stock prices have a much greater effect on stock price changes in other markets than what stock price changes in other markets have to say for US stock prices. Stock prices in the US continued to rise in the early 1990s, even though stock prices in Japan fell. But when US stock prices fell in 2001, stock prices also fell in Tokyo, London and Frankfurt. (Kindleberger and Aliber, 2005)

Li (1999) exemplifies by showing that in a situation where both the United States and emerging financial markets experience high volatility at the same time, results in a higher correlation between the markets, and then also the less effective state of risk reduction through international diversification. The most effective state of risk reduction for an US investor proved to be when the US market has low volatility, while the other markets have high volatility.

4.0 Research Question

According to modern international portfolio theory, international diversification is advantageous as assets listed in different countries will have lower correlation, compared to shares listed in the same country, and the total portfolio risk will then be reduced (Eiteman 2013). However, as illustrated in the literature review, a number of papers suggest that increasing market correlations reduces the potential benefits of international diversification. Given the background of the study, the purpose of this paper is to investigate potential diversification opportunities for the average developed markets investor by analysing emerging markets country correlations. I

believe that it is possible to construct a portfolio that quickly adjusts to changes in correlations, and exploits country correlations in a more efficient manner compared to value weighted or equally weighted EM indices.

5.0 Analysis

5.1 Market classification

In order to explore the investment opportunities of other markets, it is necessary to understand the classification of markets and what this entails. A number of companies and stock market index providers classify markets. Sometimes the market classification can differ among companies, yet big differences are very rare.
The Morgan Stanley Capital International (MSCI) is probably the most famous market classifier and the MSCI indices are leading benchmarks to measure the performance of global portfolios. The MSCI Market Classification framework determines the investment universe classification of all countries based on economic development, size, liquidity and market accessibility. (MSCI, 2017)

5.1.1 Developed Markets

Representing the developed markets is the MSCI World index, which is a frequently used benchmark for global portfolios. The index has been calculated since 1969 and contains a collection of stocks from of all the developed markets in the world, as defined by MSCI. The MSCI World Index captures large and mid cap representation across 23 countries. Today the index countries are represented by: United States, Canada, Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Australia, Hong Kong, Japan, New Zealand, Singapore. (MSCI, 2017)

The US is by far the biggest component representing almost 60% of the index. Other big economies are Japan (8%), UK (6%) and Germany (3%).

5.1.2 Emerging Markets

The MSCI emerging Markets index was launched in 1988. Back then it only consisted of 10 countries representing less than 1% of the total world market cap. Today however the MSCI EM consists of 23 member countries from all regions representing more than 10% of the total world market cap. Today the countries included are:
Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Qatar, South Africa, Taiwan, Thailand, Turkey and United Arab Emirates.
The biggest components of the index are Brazil, Russia, India and China commonly referred to as the BRIC or the BRICS, which includes South Africa as well.
Today, the BRICS represents almost 50% of the EM index, mainly due to the great growth of Chinese economy during recent years. China represents more than 25% of the EM index. (MSCI, 2017)

5.1.3 Frontier Markets

In addition to the developed and emerging markets, MSCI also classifies markets as frontier markets. Frontier markets are a group of developing countries that exhibit characteristics similar to emerging markets but are in earlier stages of macroeconomic and capital markets development. These markets are excluded from the major emerging markets and global equity indices (Senay, 2017). Frontier equity markets typically have modest market capitalization, limited investability and liquidity. Long term prospectus of frontier markets are usually good, but are commonly excluded from portfolios due to the lack of liquidity and investability. However, many investors finds similarities between frontier markets today and the early stages emerging

markets behavior. Studies have also shown significantly lower correlations between frontier and developed markets, compared to what the emerging markets can offer. (Berger, Pukthuanthong and Yang, 2011)

The frontier markets today are: Argentina, Croatia, Estonia, Lithuania, Kazakhstan, Romania, Serbia, Slovenia, Kenya, Mauritius, Morocco, Nigeria, Tunisia, Bahrain, Jordan, Kuwait, Lebanon, Oman, Bangladesh, Pakistan, Sri Lanka and Vietnam. Argentina and Kuwait are the biggest frontier markets representing 18% and 17% of the index respectively. (MSCI, 2017)

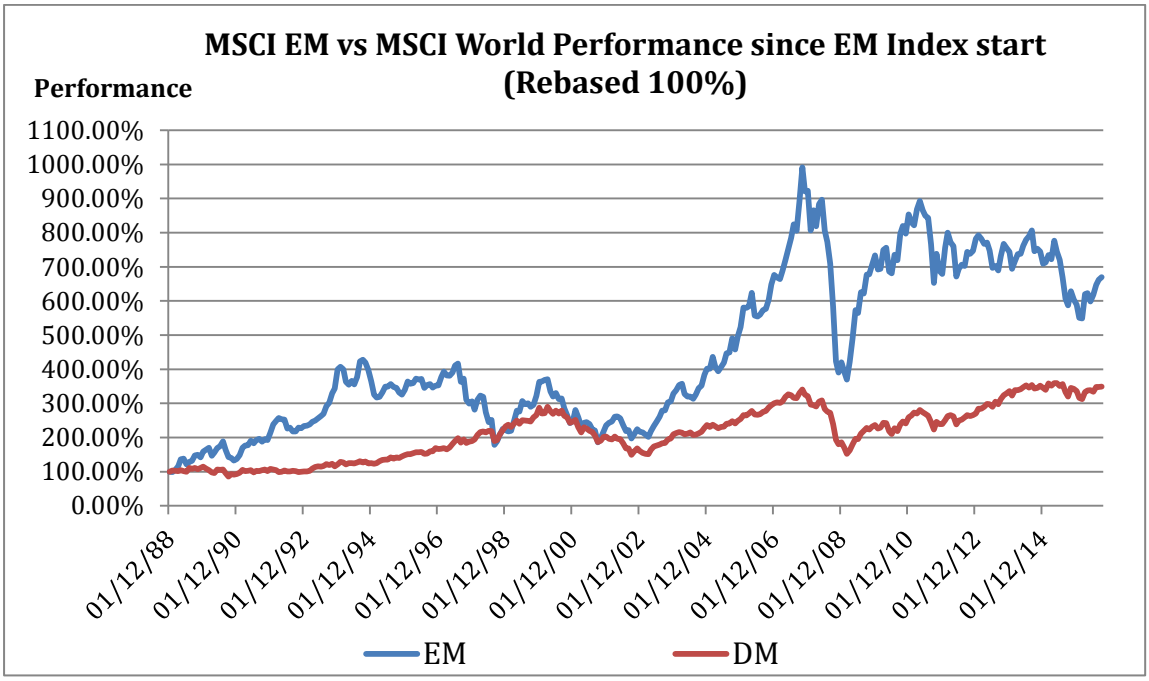
5.2 Investing in Emerging Markets

From Modern Portfolio Theory we know that diversifying investments over several geographic markets can generate a better risk-reward than one would achieve without. In addition to this, many investors look towards emerging markets due to the growth potential. Today, emerging markets are also quite easily investable through indices and funds.

5.2.1 Historical returns

The attractiveness of emerging markets can easily be examined by looking at the historical returns. Comparing the MSCI EM with the MSCI World shows that emerging markets have significantly outperformed the MSCI World since index start in 1988.

Figure 1: Historical Performance of emerging and developed markets since EM index start



5.2.2 Equal weighted vs Value weighted indexes

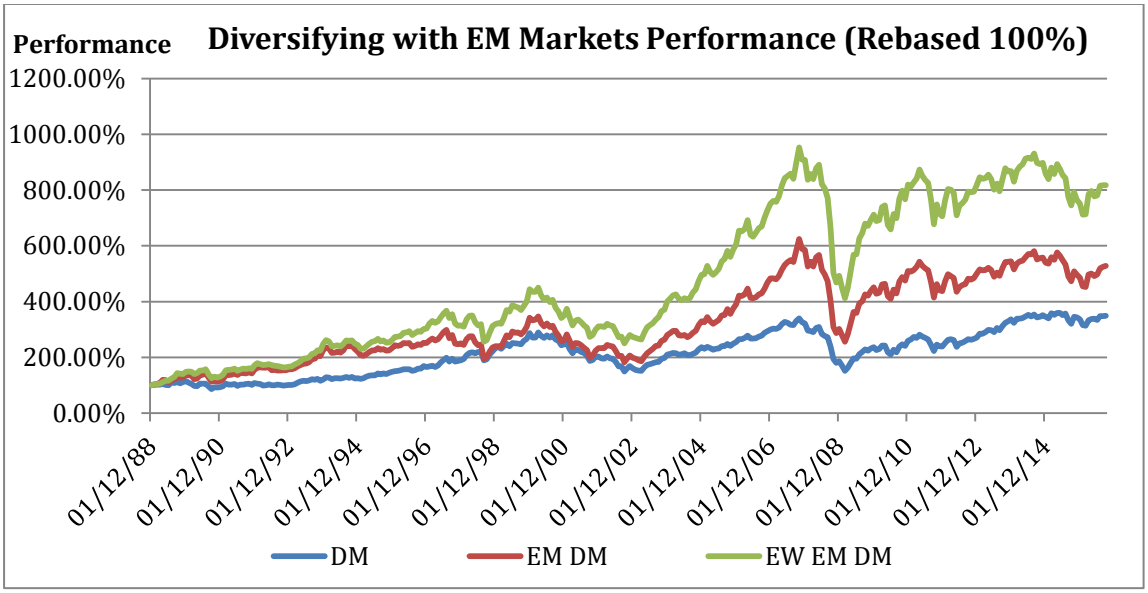
The MSCI Emerging Markets Index is commonly used to analyze emerging markets performance. However, as the EM Index is value weighted, a significant part of the index is concentrated to a few countries. This of course, means that the index will very much depend on the performance of big economies such as China, India and Brazil. Hence, when evaluating emerging markets as a whole it can also be interesting to look at an equally weighted country index which will better show the performance of all emerging markets. Equally weighted indices would also be more appealing for pure diversification purposes as the investment is spread across a higher number of countries. Historically, an equally weighted emerging market index has also given greater return potential, mainly due to the higher exposure to the small and more volatile growth economies. The disadvantages with an equal weighted index are however that it is very difficult to maintain the equal weightings, and frequent rebalancing is required. This will also give higher transaction costs. Another risk

when it comes to emerging markets is that equally weighted indices does not take into account geography or country borders, and can lead to portfolio that invests heavily within one region just because of a high number of countries.

5.2.3 Diversifying with Emerging markets

Emerging markets is typically presented as a diversification opportunity and it is therefore more relevant to investigate the historical performance of a portfolio combining emerging and developed markets. The below graph shows three portfolios, DM represents a developed market portfolio while EM DM and EW EM DM diversifies by investing 50% in emerging markets and 50% in DM , where EW EM means equally weighted emerging markets weights, rebalanced each month.

Figure2: Diversifying with Emerging Markets



As seen in the graph, both portfolios including emerging markets outperforms the developed market portfolio. However, one of the main concerns for investors seeking to invest in emerging markets is the EM volatility. Historically, emerging markets are considerably more volatile compared to developed markets. This is can also be seen in the performance statistics below. It is therefore necessary to evaluate the risk adjusted return. The sharpe ratio is one of the most used ratios used to compare

portfolio performance and gives the risk adjusted return based on volatility and return. Another commonly used ratio is the alpha which gives the excess return relative to the market, the alpha is often used to indicate the portfolio managers performance.

Figure 3. Performance Statistics of diversified Portfolios

	DM (Market)	EM DM	EM EW DM
Average annual return	5.3%	7.0%	8.6%
Annualised volatility	14.95%	17.91%	16.80%
Risk free rate	3.03%	3.03%	3.03%
Sharpe Ratio	**0.15**	**0.22**	**0.33**
Beta	1.00	1.08	1.01
Alpha (Compared to DM)	**0.00%**	**1.50%**	**3.21%**

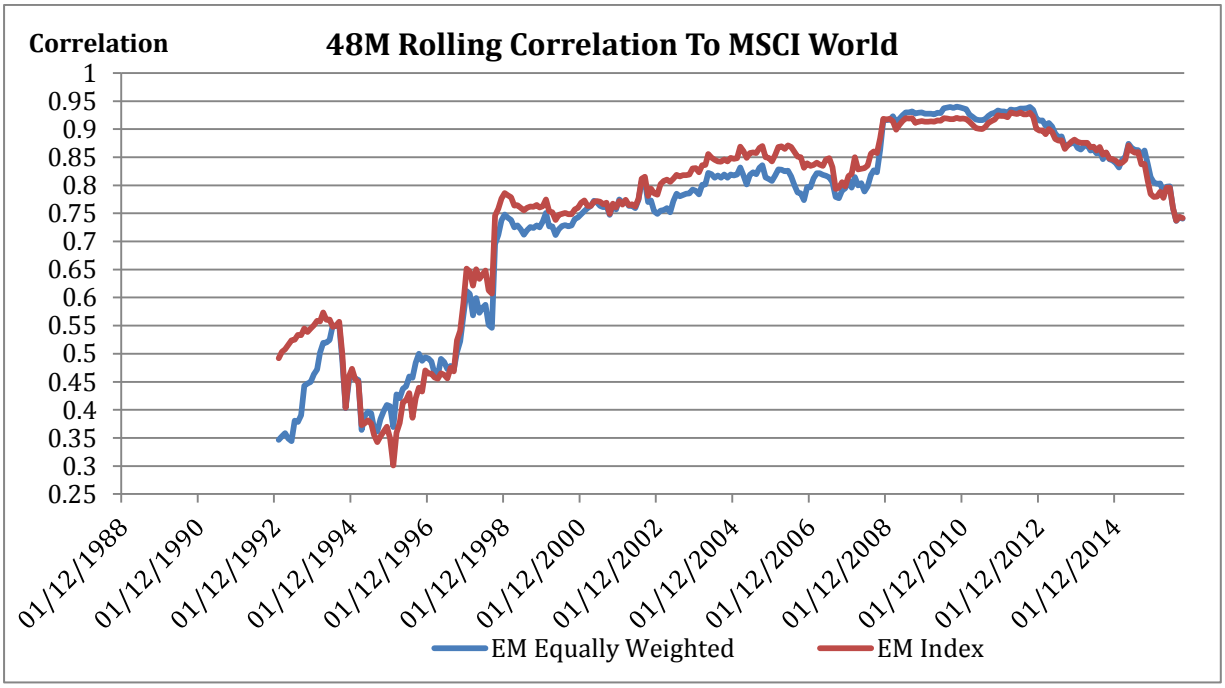
From the table one can see that both the alpha and the Sharpe ratio increases when including emerging markets, indicating that a higher risk adjusted return can be achieved by diversifying with emerging markets. Furthermore, the beta illustrates the systematic risk relative to the market and indicates that the emerging market portfolios are slightly more volatile than the market. However, as the alpha clearly shows. Both emerging markets portfolios outperforms the market.

5.3 Increasing correlation

The historical performance of emerging markets displays a substantial higher risk adjusted return. However, today emerging markets play a different role compared to 20 years ago. The lower correlations among international markets are one of the main arguments in favor of international diversification. Yet, there is strong evidence suggesting that the benefit of emerging markets has diminished due to increased correlation. EMs presents a very different investment proposition, having established themselves as major players in the global economy. Comparing the correlation

between each emerging market to the MSCI World Index before and after year 2000 (appendix figure 1) confirms that every single emerging market have a significantly higher correlation to the MSCI world after year 2000. The Increasing correlation can also been seen by looking at the rolling correlation of EM is respect to the MSCI World.

Figure 4: 48 month rolling Correlation of Emerging markets to MSCI World



As seen in the graph, correlation has increased for both the EM Index and an equally weighted emerging markets portfolio. Since year 2000, rolling correlation has been constantly over 0.7.

6.0 Methodology

The development of emerging markets has clearly affected market correlation and therefore also the diversification benefits. In this part of the thesis I look at an investment approach that takes into account the changing correlation of markets. By analyzing each EM country's correlation I will construct a portfolio that delivers

higher allocations to the less correlated markets.

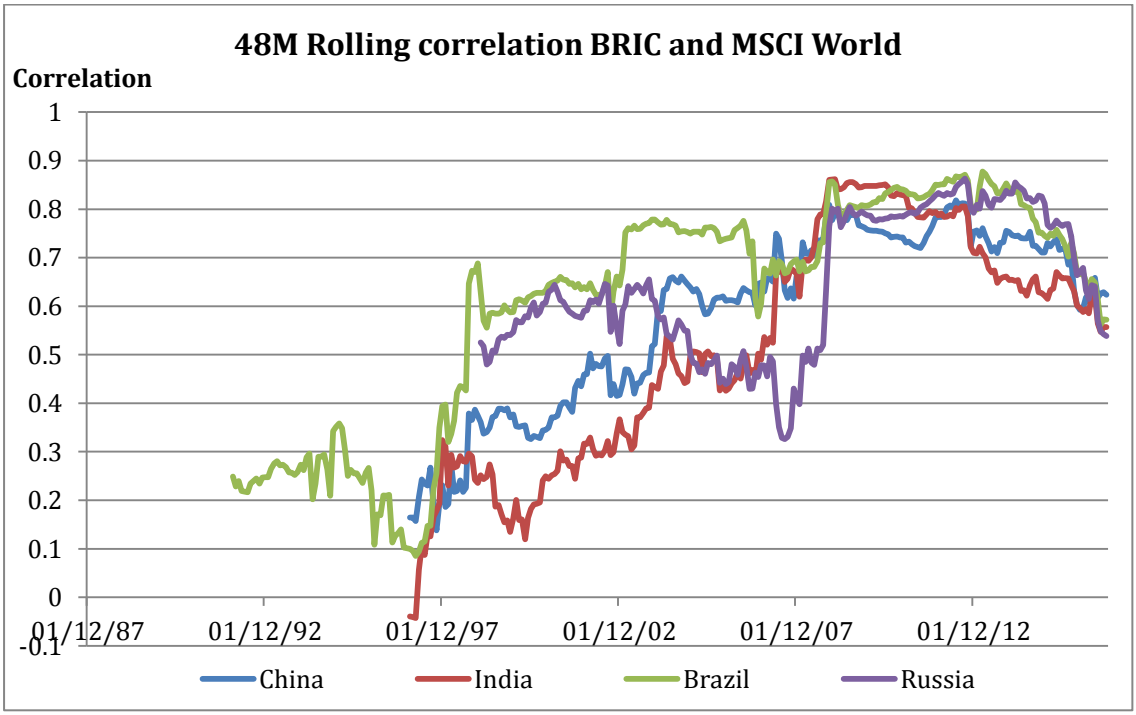
6.1 Data

In order to find the country returns the MSCI Country Index price in USD for each of the emerging markets is downloaded. This is the monthly price in USD and the data used dates back to the EM index start in 1988. However for most of the EM countries there is no data dating all the way back to 1988 and the data available is used.

6.2 Correlation vary over time

Evaluating the historic correlation between countries shows clear patterns and trends. The 48 month rolling correlation illustrated with the BRIC countries demonstrates a clear increasing tendency in the world correlation:

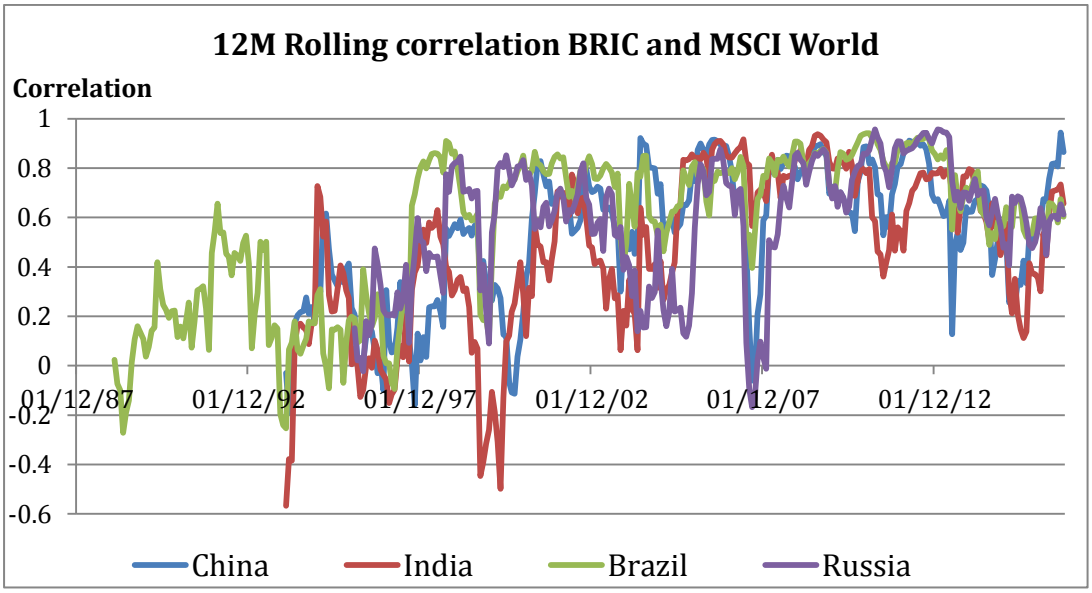
Figure 5: 48 month rolling correlation BRIC countries to MSCI World



The same trend can be seen for most emerging markets countries as seen in appendix figures 2-5. The graph also a show that country correlation varies greatly, meaning that it is difficult to base investments decisions purely on long term historical correlation. For a forward looking portfolio the 48 month rolling correlation is likely

to be too "slow" and not adaptable to these sudden changes in correlation. Hence, for the purpose of creating a forward looking portfolio, it can be more efficient to use data based on a shorter time period in order to better track changes and market conditions. For this reason the 12 month rolling correlation between each EM country and the MSCI world is calculated:

Figure 6: 12 month rolling correlation BRIC countries to MSCI World



Again represented by the BRIC. The 12 months data shows the same pattern with an increasing correlation but with even higher movements, fluctuations and more extreme numbers.

6.3 Country ranking

Based on the 12 month rolling correlation to the MSCI World as described above, each emerging market member is given a correlation coefficient. Hence the first correlation calculations are made 12 months after index start in 1988. This number is then transferred into a ranking table where the country with the lowest correlation is given rank 1 and the second lowest correlation rank 2 etc.

As the number of countries included in the EM market Index is not constant the ranking of countries is adapted to only include countries that are included in the EM

Index at the specific point in time. This means that a number of market reclassifications needs to be taken into account as shown in appendix figure 6 and that the number of countries included will vary over time illustrated in appendix figure 7.

6.4 Country weights

The idea behind the portfolio is to increase weightings in markets that are less correlated to the MSCI World Index. However, it is also necessary to include some constraints and fixed weights in order to make the portfolio more investable.

1. All countries will be included and no short positions. Every EM country will be included in the portfolio. Excluding countries purely based on the historic correlation will in most cases increase portfolio volatility. Also, the historic correlation is only an indication and the numbers for coming periods may be very different.
2. BRIC weights. Basing weights purely on correlation may lead to a portfolio with very high exposure in specific regions and in smaller, less developed emerging markets. Even though this can reduce portfolio volatility and potentially boost returns, it increases macroeconomic risks. Therefore a special attention is given to the BRIC members. The BRIC countries are powerful, big economies representing three different continents and almost half of the world population. Consequently, the BRICs are given minimum weights when constructing a correlation-based portfolio. In order to determine realistic minimum weights for the BRIC members, representing a fair market value at a given point in time, the historic country weights of the MSCI EM is considered (MSCI, 2017). Minimum weights for the BRICs countries are summarised below:

Figure 7: BRIC weightings

	2000-2005	2005-2010	2010-2016
China	6%	8%	20%
India	6%	5%	8%
Brazil	10%	11%	16%
Russia	2%	5%	5%
Total minimum BRIC weight	**24%**	**29%**	**49%**

The weights for China, India, Brazil and Russia will then be the predetermined minimum weight + the ranking based weight.

The weightings based on the ranking table must therefore be adjusted to reflect both the BRIC weights and the number of countries to be included in each period.

Figure 8: Portfolio weightings

	2000-2005	**2005-2010**	**2010-2016**
BRIC weight	24%	29%	49%
Correlation Ranking table	76%	71%	51%
Total	100%	100%	100%

The weighting of each country is given by:

$$W_R = W_{R1} - \big((R-1) \times 0.15\big)$$

Where R represents the corresponding ranking.0.15 is the reduction factor that is used, hence for each rank, the weight will be reduced by 0.15. W_{R1} represents the weighting of the 1st ranked country. In order to establish this weight (W_{R1}), both the number of countries and periods must be taken into account. The weight of the first ranked country is given by solving the following equations:

For the period 2000-2005:

$$76 = W_{R1} + (W_{R1} - 0.15) + (W_{R1} - 2 \times 0.15) \ldots\ldots + (W_{R1} - (Number\ of\ countries\ ranked - 1) \times 0.15)$$

For the period 2005-2010:

$$71 = W_{R1} + (W_{R1} - 0.15) + (W_{R1} - 2 \times 0.15) \ldots\ldots + (W_{R1} - (Number\ of\ countries\ ranked - 1) \times 0.15)$$

For the period 2005-2010:

$$51 = W_{R1} + (W_{R1} - 0.15) + (W_{R1} - 2 \times 0.15) \ldots\ldots + (W_{R1} - (Number\ of\ countries\ ranked - 1) \times 0.15)$$

Please see appendix figures 8-10 for full equations with number of countries and the results in each period.

After determining the weight of the 1st ranked country, we can easily define the other weights which are reduced by an interval of 0.15 based on the ranking. Given by the formula:

$$W_R = W_{R1} - \big((R - 1) \times 0.15\big)$$

Where R represents the corresponding ranking. W_{R1} Represents the weighting of the 1st ranked country as calculated above. The full weighting tables can be seen in the appendix figures 12-14.

The interval of 0.15 is used as this ensures that all countries are given positive weights (long positions) irrespective of the number of countries, nor the period. This can be illustrated by the weightings of the most correlated (highest ranked) countries in each period (appendix figure 11). The lowest weight given to any country irrespective of period will be 0.24%.

6.4 Portfolio construction

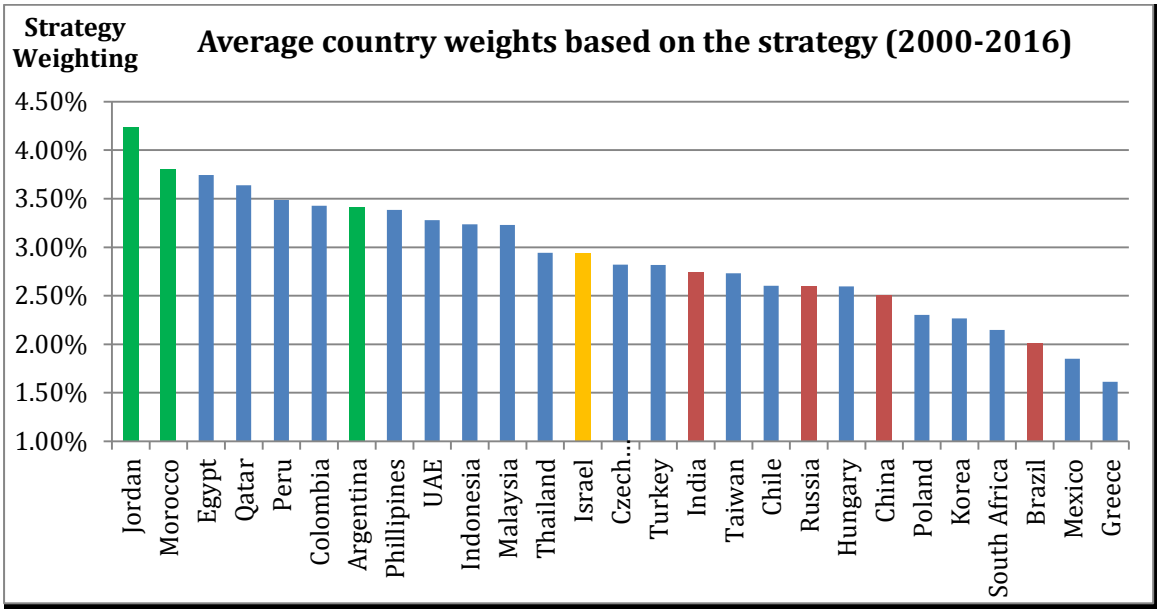
The weightings are then used to calculate weighted returns and this is summed to give the returns of the strategy. Portfolio start is set to January 2000, which ensures that data from all emerging markets are available. The portfolio weights are rebalanced and changed each month, based on the monthly updated ranking table.

7.0 Results

7.1 Country weights

In order to analyze the strategy it is necessary to look at the countries that are given high weights. The table below shows the average weights given by the strategy ranking. The BRIC countries are marked with red. Green represents markets that today are classified as frontier markets and orange represents markets that today are among the developed markets.

Figure 8: Average country weights of the Strategy



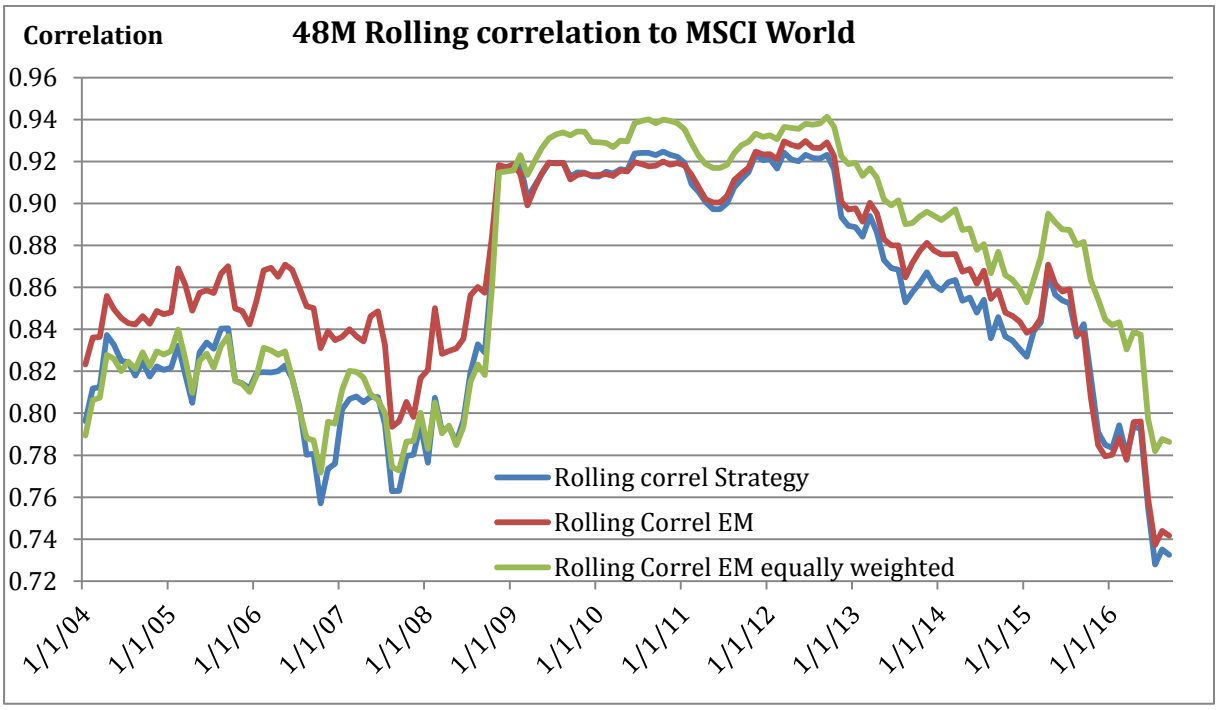
Even though the graph shows some clear trends and some markets are given very low average weights, it is also notable that the weightings do not fluctuate very much between countries. Most countries have an average weight between 2- 3%. This implies that the ranking for all countries changes frequently. This can also be seen by looking at the ranking graphs of the BRIC members in the appendix figures 15-18. Unsurprisingly, Greece is given a low average weight as this market behaves very much like the developed markets, and it has also been classified as a developed market for long time periods. Furthermore, markets dependent on the US economy such as Mexico and Brazil are also given low

average weights. On the other side of the graph we find the Middle East and African countries. It is also notable that all the countries that today are reclassified as frontier markets are given high weights.

7.2 Correlation of Strategy vs Traditional EM indices

The strategy aims to use past correlation to predict future correlation. And then reduce overall correlation to the developed markets and boost diversification benefits. Looking at the 48 month rolling correlation, the strategy demonstrates slightly lower correlation compared to the EM Index and equally weighted EM portfolio. The overall correlation coefficient for the strategy is 0.83 which is slightly lower than the EM index of 0.85 and the equally weighted EM of 0.84.

Figure 9: Strategy Correlation to MSCI World



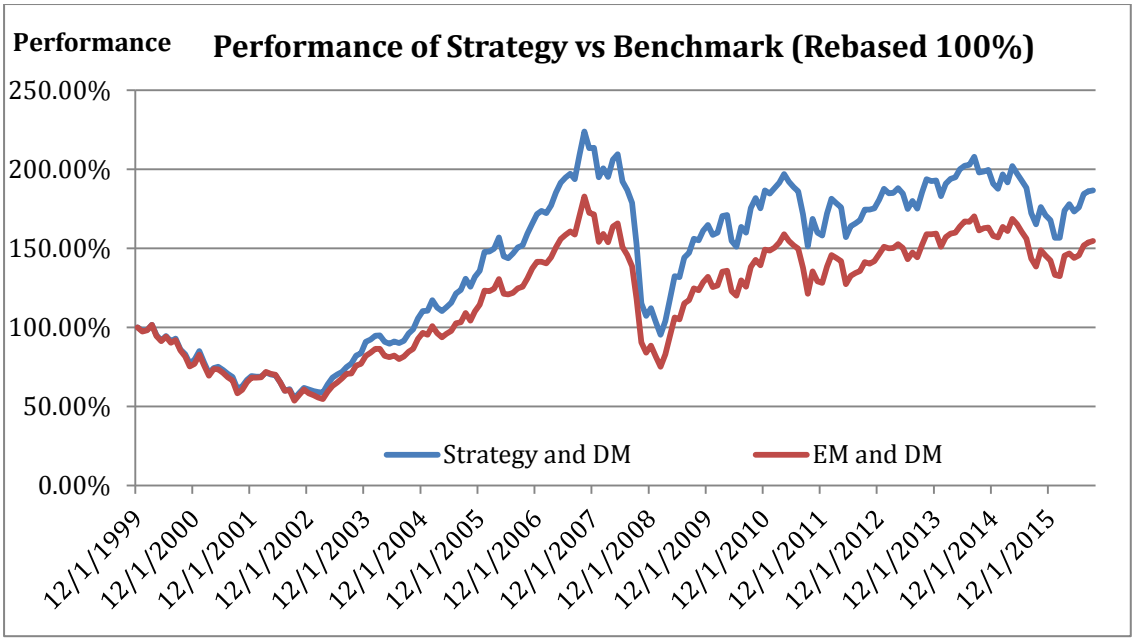
7.3 Performance Statistics

The strategy is created to exploit benefits of international diversification in a portfolio combining emerging and developed markets. For this reason, the performance of the strategy is analyzed by looking at the strategy combined with

a developed market portfolio. Hence, the final portfolio used for the summary statistics includes 50% weight in the MSCI World Index and 50% weight in the Strategy created.

The benchmark used is a portfolio of 50% MSCI World and 50% MSCI Emerging Markets Index, while the market is represented by the MSCI World index alone.

Figure 10: Performance of Strategy vs Benchmark



The performance graph clearly shows that the portfolio including the strategy outperforms the benchmark portfolio. It is also very clear that both portfolios follow the same trends and market movements. However, the purpose of the strategy is not to boost performance, but to achieve a better risk adjusted performance.

Figure 11: Summary Statistics of Strategy vs Benchmark

	Market (MSCI WORLD)	EM and DM	Strategy and DM
Total Return	21.5%	54.6%	86.6%
Volatility	4.48%	5.29%	5.20%
Max drawdown	-55.4%	-59.0%	-57.4%
Average Annual return	2.90%	4.97%	6.13%
Annualized volatility	15.53%	18.32%	18.00%
Risk Free Rate	3.03%	3.03%	3.03%
Sharpe Ratio	**-0.01**	**0.11**	**0.17**

Beta	1.00	1.12	1.09
Alpha (compared to MSCI World)	**0.00%**	**2.09%**	**3.25%**

The risk free rate is given by the average 5y USD risk free rate over the portfolio lifetime illustrated in the appendix figure 19.

As the goal is to achieve a better risk adjusted return it is important to study the risk measures of the portfolios. The volatility of the strategy is slightly lower compared to the benchmark EM, and the max drawdown is also lower. The lower risk is also illustrated by the lower beta. Naturally this gives a significantly higher Sharpe ratio and an Alpha that indicates that the strategy portfolio outperforms both the market and the benchmark.

The higher return in the portfolio compared to the value weighted EM index can be partially explained by higher weights in smaller emerging markets. Yet, it also means these also results implies that the strategy works well with a developed market portfolio, and that the strategy gives more protection against downturns, and reduces volatility compared to the benchmark. The lower correlation to the MSCI world increases the chances of protecting against downturns without affecting potential returns. In summary the statistics highlights that investors can benefit from diversifying with emerging markets, and boost the risk adjust returns even further by using a correlation based investment strategy.

8.0 Conclusion and discussion

This paper looks into the benefits of international diversification in an increasingly correlated world. The research is presented from a developed markets investors' point of view, seeking to explore opportunities globally. Historically, a portfolio including emerging markets outperforms a portfolio only consisting of developed markets.

However, I argue that we can see a clear trend for increasing correlation in the world markets, and that the growth of emerging markets has reduced the diversification benefits in markets that were previously highlighted as uncorrelated. Furthermore, I show how correlation varies over time, and that there are still emerging markets that are highly uncorrelated to the rest of the world in some periods. By analyzing the correlation of all emerging markets against the MSCI world, countries are ranked and allocation weights are set aiming to take advantage of the uncorrelated countries in a more efficient manner. Additionally, I propose a number of constraints to ensure an adequate allocation to larger emerging markets in order to avoid over exposure in smaller and less developed emerging markets. The ranking weights are also set to include all markets. This makes the idea more investable and realistic. My findings suggest that a superior risk adjusted portfolio can be composed by considering short-term correlation coefficients when determining the country allocations. Even though the portfolio constructed outperforms the benchmark, some of the results were surprising. The correlation between the strategy and the MSCI World was only slightly lower than the EM Index or the equally weighted portfolio. This can partially be explained by the BRIC weightings in the strategy, but it also suggests that the 12 month rolling correlation does not predict future correlation accurately. Another important limit to the research is the fact that transaction costs are not included in the study. Monthly rebalancing in several markets would mean higher transaction costs compared to investing in value weighted indices. Furthermore, the portfolio constraints of the BRIC countries can be adapted in future research to more accurately reflect the market cap given at each period. For example setting the BRIC weights similar to the EM Index each period. It would also be interesting to look at portfolios with different

constraints. For example, higher weights allocated to the top ranked countries, or excluding some countries based on high correlation. My paper does not look into the inclusion of frontier markets, mainly due to the lack of data, yet this would also be interesting for future studies as frontier markets would reduce correlation even further.

In summary, I believe that the average investor seeking to diversify their portfolio should be more selective in respect to which countries that should be included, as countries with higher correlation will generate smaller diversification benefits. Emerging markets are still not perfectly correlated to the world, and remains an exciting investment opportunity for investors seeking to boost risk adjusted returns. Yet, it is important to understand that emerging markets have changed and investors must adapt to this in order to really benefit from international diversification.

9.0 References

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